Isotopic study of the Himalayan metamorphic rocks in the far-eastern Nepal

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Previous studies have documented that Sr-Nd and U-Pb zircon isotopic compositions are different between the Lesser Himalayan and the Higher Himalayan metamorphic rocks in Nepal, India, and Pakistan (Parrish and Hodges 1996, Ahmad et al. 2000). However, not much attention was paid to the metamorphic rocks of Main Central Thrust (MCT) zone. We report the result of Sr-Nd isotopic studies in the Higher Himalayan zone, the Lesser Himalayan zone and the MCT zone in far-eastern Nepal.

Far-eastern Nepal (Kangchenjunga-Taplejung-Ilam region) comprises three distinct tectonic units: the Higher Himalaya, the Lesser Himalaya and the Sub-Himalaya (Shelling and Arita 1991). Each of these tectonic units is a fault-bound tectonic package. The Higher Himalayan metamorphic rocks consist of medium- to high-grade paragneisses and orthogneisses. The Lesser Himalayan metamorphic rocks comprise primarily meta-sandstones with intercalations of phyllites and meta-quarzites. The Ilam Nappe is composed of the Higher Himalayan metamorphic rocks. It is a geologically siginificant unit in far-eastern Nepal. The Ilam Nappe with no overlying the Tethyan sedimentary rocks has been thrust over the Lesser Himalayan thrust package along the MCT zone up to near the Sub-Himalaya zone in the south.

The MCT zone is a ductile-brittle zone with a thickness of less than 1 km to several km. The upper boundary of the MCT zone is known as the Upper MCT (UMCT) and the lower one as the Lower MCT (LMCT). The lithology of the MCT zone is characterized by mylonitic augen gneiss, biotite-muscovite-chlorite phyllite with S-shaped garnet and graphitic phyllite. Compositions and zoning patterns of garnets can be discriminated between the MCT zone and the Higher Himalaya.

Information on the tectonic disposition prior to the Himalayan orogeny of the geologic units juxtaposed by the MCT is important for understanding the crustal shortening and changes of thermal structure due to the MCT activity. In general, the Higher Himalayan sequence has been considered to be Indian basement in origin, and the Lesser Himalayan sequence has been deposited on the northern margin of the Indian continent in the Precambrian times. However, the Higher Himalayan sequence in the Langtang area, central Nepal yields zircon U-Pb ages of 0.8 to 1.0 Ga, implying a sedimentary provenance of the Late Proterozoic. On the other hand, the Lesser Himalayan sequence contains 1.8 to 2.6 Ga zircons. Therefore, it was proposed that the Higher Himalayan sequence is metasedimentary rocks that were originally deposited north of continental margin than the Lesser Himalayan sequence (Parrish and Hodges 1996). Furthermore, Nd isotope data are useful in distinguishing between Higher Himalayan and Lesser Himalayan zones (Ahmad et al. 2000). These data show that the ε_{Nd} values for t=1000 Ma in the Higher Himalayan are -10 to -3, whereas these of the Lesser Himalayan are -17 to -7. We have recalculated ε_{Nd} values at 1000 Ma as this time corresponds to a "Grenville" thermal event in the Himalayas.

17 Samples in the far-eastern Nepal were collected from the Lesser Himalayan, the Higher Himalayan and the MCT zones by the tectonostratigrapic units (**Figure 1**). The isotopic work presented in this study follows on the structural and petrological studies of Schelling and Arita (1991). In study area the ε_{Nd} values for t=1000 Ma from rocks of the Higher Himalaya and the Lesser Himalaya are almost within the range of the previous data except for the Tamar Khola Granite. The ε_{Nd} values for t=1000 Ma obtained are -10 to -2 in the Higher Himalaya and -17 to -15 in the Lesser Himalaya. The Tamar Khola Granite has the ε_{Nd} value for t=1000 Ma of –11 and the high $^{147}Sm/^{144}Nd$. Most samples from the MCT zone have the middle ε_{Nd} values for t=1000 Ma (-15 to -11) of the samples from Higher Himalaya and Lesser Himalaya (**Figure 2a**). Similarly, the $^{87}Sr/^{86}Sr$ values obtained from the MCT zone show the values between those of Higher Himalayan and Lesser Himalayan zones although a few rocks units of Lesser Himalaya have very high $^{87}Sr/^{86}Sr$ values (**Figure 2b**).

These data may serve to strengthen the opinion that the Higher Himalayan sequence is not Indian basement in origin. Further, these data may suggest that the rocks of the MCT zone fill a gap between the Higher and Lesser Himalayan sequence although Sm-Nd isotopic signiture from them indicate that they had different sediment sources area. Finally, both the Higher and the Lesser Himalayan sequence, including the rocks of the MCT zone between them, may represent thick clastic successions deposited on the north of the thinned continental margin of the Indian basement.

References

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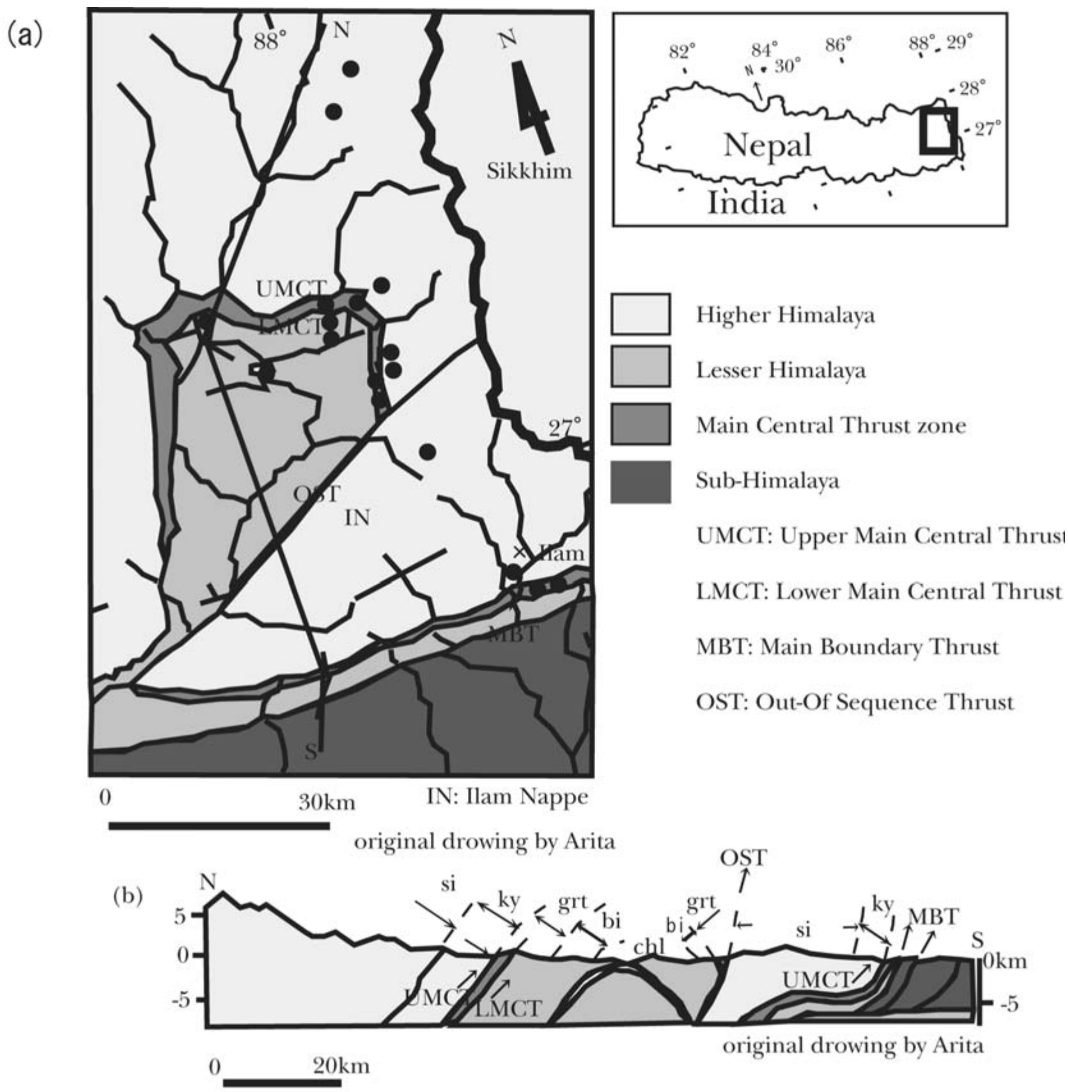

FIGURE 1. Geologic map (a) and cross section (b) of the far-eastern Nepal with sample locations

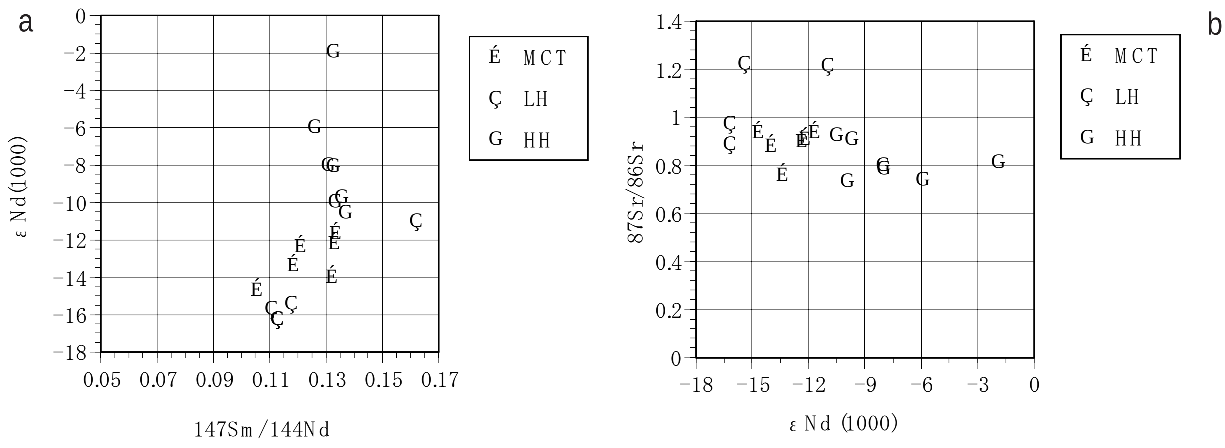

FIGURE 2. ε_{Nd} values for = 1000 Ma vs. $^{147}Sm/^{144}Nd$ (a) and $^{87}Sr/^{86}Sr$ vs. ε_{Nd} values for t=1000 Ma (b) for Far-eastern samples